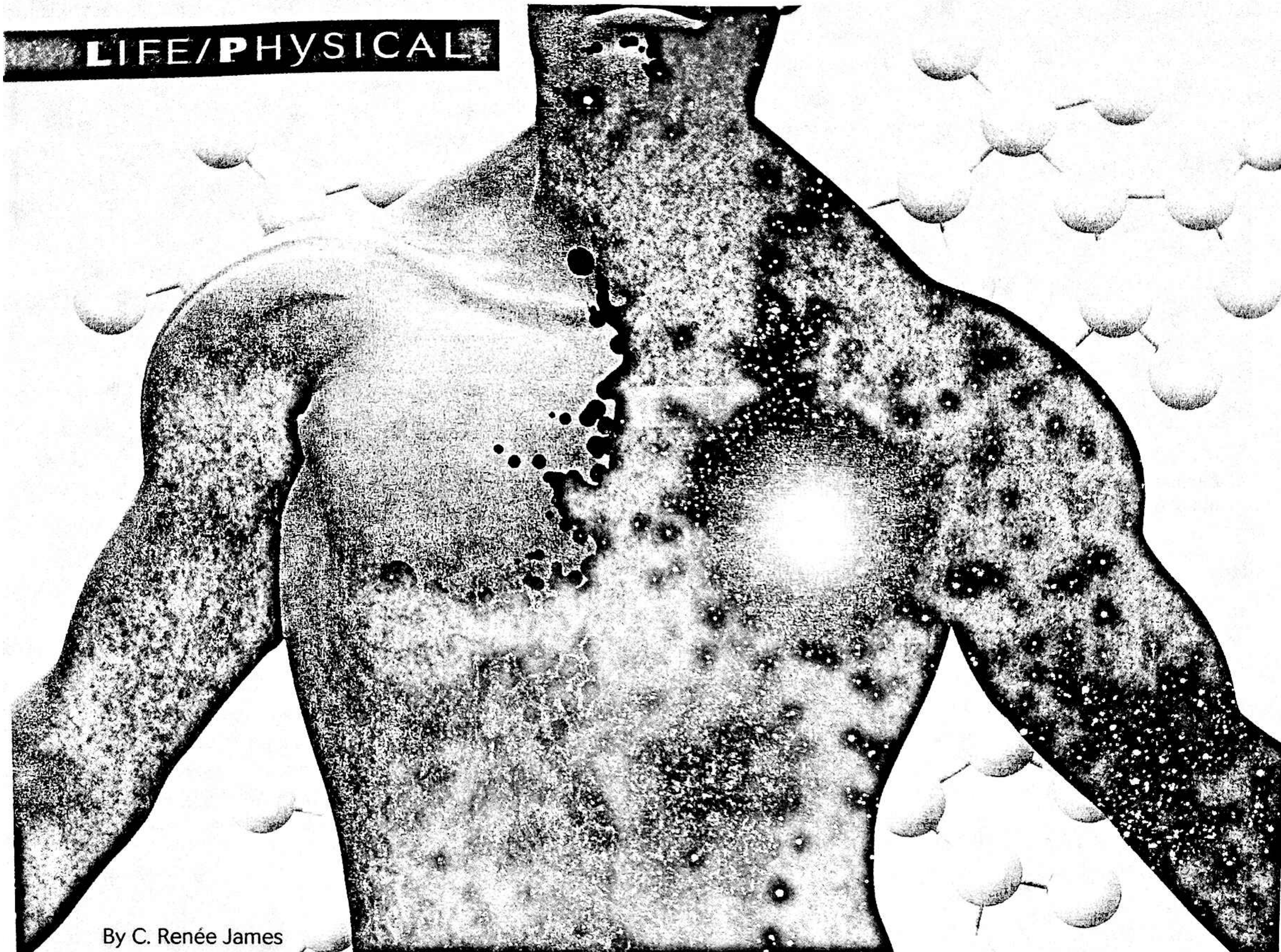


By C. Renée James

STARSTRUCK

Where did the elements in our bodies come from?

It finally happened in my house. The Dreaded Question: "Where do babies come from?" After some stuttering and blushing, I decided to tell my son the truth about his newborn sister: She's a child of the universe.

So are the rest of us. The majority of our atoms have been riding unchanged through the universe since its own birth, the big bang, 13.7 billion years ago. The big bang created hydrogen, the most abundant element in the universe—and in the human body.

As vital as hydrogen is, life also depends on many other elements in smaller quantities. Those elements arose in mighty cosmic cauldrons—the stars—as the universe evolved. This is their history.

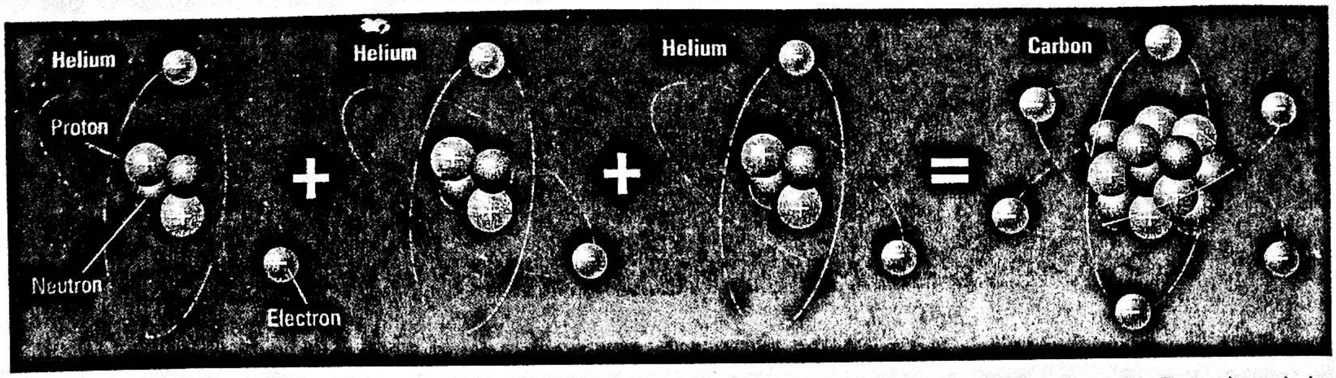
FUSION 101

The vast clouds of hydrogen that filled the infant cosmos eventually lost their battle with gravity. They pulled together, and their centers heated to temperatures of at least 15 million degrees Celsius. The first stars were born.

At 15 million degrees, *protons* (positively charged atomic particles) move around the core of a star at lightning speed. Normally, particles with the same charge repel one another. However, the protons deep inside the first stars moved so fast that they collided. When that happened, they behaved as if they were coated with a powerful glue and stuck together. That process is called *fusion*, and it creates a heavier element out of lighter ones. The lightest element, hydrogen (with one proton in each atom), became helium (two protons).

Helium is a *noble* (inert) gas, and it doesn't bond to form the molecules necessary for life. A human body has no helium. Nevertheless, helium was a necessary building block for the creation of heavier, life-giving elements. Before that happened, though, stars had to die.

Top: Shutterstock (3)



Particle Physics At the moment of the big bang, the universe was too hot for any known particles to exist. But as it cooled and expanded, subatomic particles started to form. Electrons came first, then protons and neutrons. Elements formed later from the fusion of those particles. The identifying trait of any element is the number of protons—not neutrons—in its nucleus.

When a star burns all its hydrogen, its core heats to 100 million degrees Celsius and compresses to an even greater density. That's when helium fuses into even heavier elements—first carbon, then oxygen. Hydrogen, carbon, and oxygen make up almost all the atoms in the body: hydrogen, 62 percent; oxygen, 24; and carbon, 12. The young universe manufactured 98 percent of what people are made of.

THE OTHER 2 PERCENT

Take a look at any multivitamin label, though, and you'll see that life requires a long list of other elements in small quantities. How did they originate?

In the most massive stars—those containing anywhere from eight to 100 times the mass of the sun—fusion can continue past oxygen. The universe's first generation of massive stars crushed their cores to incredible densities and temperatures. In such extreme conditions, heavier, life-giving elements—magnesium, sulfur, calcium, and ultimately, iron—were forged.

Immediately after the creation of iron, the massive stars exploded as *supernovas*, spewing all their manufactured goods into space. As the heavier elements raced from the heart of the explosions, they were bombarded with *neutrons* (neutral atomic particles) moving at 29,000 kilometers (18,000 miles) a second. The neutrons collected rapidly on the magnesium, sulfur, and calcium. Hours, days, or even weeks later, some of the neutrons changed into protons. More fusion took place and even heavier life-giving elements emerged. Iodine, the element that the thyroid gland needs to function, came from that *rapid capturing of neutrons*, or *r-process*.

Not all the heavier elements came from cosmic catastrophes. Once the first massive stars gave their lives as supernovae, a second generation of smaller stars was born from clouds containing traces of the newly created elements. Those stars died more quietly. Instead of exploding, they compressed and expanded repeatedly. Those *thermal pulsations* resulted in short bursts of fusion near the cores of the stars. The bursts of fusion allowed iron atoms to grow into even heavier elements.

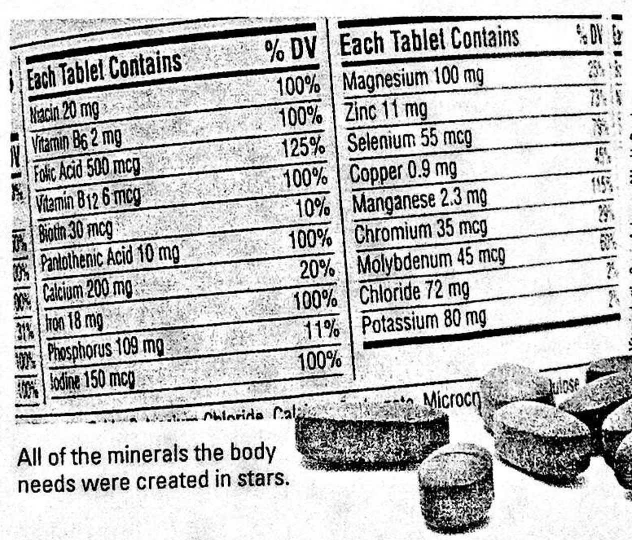
Because that process is slow in comparison to the fusion that happens in a supernova blast, it is called the *s-process*. Much of the molybdenum and virtually all the strontium, yttrium, barium, cerium, and lead in the body were made by the s-process deep within second- and third-generation stars. Then, like the globs in a lava lamp, those elements rose to the surface of the stars and were slowly shed into space. Hundreds of millions of years later, that material joined with other clouds, ultimately forming the sun and the solar system.

IRON IN THE FIRE

Finally, there's iron, which the body needs to transport oxygen through the blood. The supernovas blasted some iron into space, but most of the iron in the body came from *white dwarfs*. A white dwarf is the extremely dense leftover core of a star like the sun after it has grown old and shed its outer layers. When two white dwarfs merge, they blow themselves to smithereens in a cosmic *conflagration,* or rapid, complete fusion. In the process, they create the sun's weight in iron.

So forget snakes and snails and puppy dog tails, sugar and spice and everything nice. The next time someone asks what little boys and girls are made of, try this:

Big bang creation and thermal pulsations, r-process, s-process, huge conflagrations. **CS**



All of the minerals the body needs were created in stars.

Vitamin bottle: Carrin Ackerman/Weekly Reader; Vitamins: Shutterstock

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Vocabulary Challenge

Match each numbered word or phrase with its correct description. Write the letter of the description in the space provided.

_____ **1.** proton	A. a process in which lighter elements stick together to create heavier elements
_____ **2.** sun	B. an element that makes up about one-quarter of all the atoms in the human body
_____ **3.** hydrogen	C. an exploding star
_____ **4.** iodine	D. the event that gave birth to the universe
_____ **5.** neutron	E. a positively charged particle
_____ **6.** oxygen	F. the most plentiful element in the universe
_____ **7.** supernova	G. a neutral particle
_____ **8.** fusion	H. the dense leftover core of a star that has become old and shed its outer layers
_____ **9.** white dwarf	I. a star
_____ **10.** big bang	J. an element that the thyroid gland needs to function